

PLANT-REPORT SUMMARY = (BEPS) ..

SHW = PLANT-EQUIPMENT	TYPE = DHW-HEATER	SIZE = -999 ..
HWG = PLANT-EQUIPMENT	TYPE = HW-BOILER	SIZE = -999 ..
CHR = PLANT-EQUIPMENT	TYPE = HERM-REC-CHLR	SIZE = -999 ..

PLANT-PARAMETERS HERM-REC-COND-TYPE = AIR ..

END ..

COMPUTE PLANT ..

Additional capabilities for this system:

- 1) To simulate a variable volume dual duct air system add MIN-CFM-RATIO = .5 (i.e., a minimum stop of 50%) to the SYSTEM keyword list. [10]

- 2) To simulate variable speed control of the fan motor add FAN-CONTROL = SPEED to the SYSTEM keyword list; this will override the default of INLET control. [11]

- 3) To enable the economizer add OA-CONTROL = TEMP and ECONO-LIMIT-T = 60 to the SYSTEM keyword list. A second alternative is to simulate an enthalpy controlled economizer by changing OA-CONTROL = TEMP to OA-CONTROL = ENTHALPY and raise ECONO-LIMIT-T = 70 [12]

- 4) To simulate turning off the hot deck whenever the outside temperature is above 65°F and always during the summer months of JULY 1 through AUGUST 30, insert a new schedule like this: [13]

HEAT-OFF-SCHEDULE THRU JUN 30 (ALL) (1,24) (65)
THRU AUG 30 (ALL) (1,24) (0)
THRU DEC 31 (ALL) (1,24) (65) ..

and add HEATING-SCHEDULE = HEAT-OFF to the SYSTEM keyword list.

- 5) To enable an exhaust fan add the keywords EXHAUST-CFM = Value (CFM) and EXHAUST-KW = Value (.0001 is typical) to the ZONE keyword list. [14]

- 6) To enable a humidifier which requires heat to evaporate water into the air add MIN-HUMIDITY = Value (25% is typical) to the SYSTEM keyword list. [15]

- 7) To enable heat recovery to exchange relief air heat with outside air heat add RECOVERY-EFF = Value (0.6 is typical) and RETURN-KW = Value (.0003 is typical) to the SYSTEM keyword list. [16]

- 8) To simulate a discriminator control of the cold deck supply air temperature add COOL-CONTROL = WARMEST to the SYSTEM keyword list. [17]

- 9) To simulate a discriminator control of the hot deck supply air temperature add HEAT-CONTROL = COLDEST to the SYSTEM keyword list. [18]

- 10) Alternatives to items 8 and 9 above are reset of cold and hot deck supply air temperature. An example of this control is covered in the *Sample Run Book (2.1E)*, 31-Story Office Building, Run 1. [19]

- 11) To simulate turning off the hot deck whenever the outside temperature is above 65°F, insert a new schedule like this: [20]

HEAT-OFF = SCHEDULE THRU DEC 31 (ALL) (1,24) (65) ..

and add HEATING-SCHEDULE = HEAT-OFF to the SYSTEM keyword list.

Variable-Volume Fan System with Optional Reheat (VAVS)

In its most basic configuration VAVS consists of a central air-handling unit with filter (not shown), cooling and optional heating coils, and a draw-through type supply air fan. Exhaust fans are optional for any or all zones. A duct system distributes supply air (at a temperature determined by you) to variable-air volume (VAV) terminal units, located in the zones being served.

The VAV boxes (controlled by a room thermostat) vary the amount of primary air to the space to control temperature. When the space demands peak cooling, the VAV box allows maximum air flow. As space cooling requirements diminish, the primary air flow to the space is reduced proportionately to a specified minimum flow rate. If less cooling is required than that given at minimum air flow, the reheat coil is activated (if specified). When in the heating mode, the supply air flow rate is held at a constant value equal to MIN-CFM-RATIO. The supply air flow rate will rise above the MIN-CFM-RATIO only if you have set THERMOSTAT-TYPE = REVERSE-ACTION.

The Btu equivalent of the moisture that is added to the air stream, to maintain a minimum humidity, is passed to the PLANT program as a heating load.

Note: On the schematic, items shown in dashed boxes are optional components.

BM012

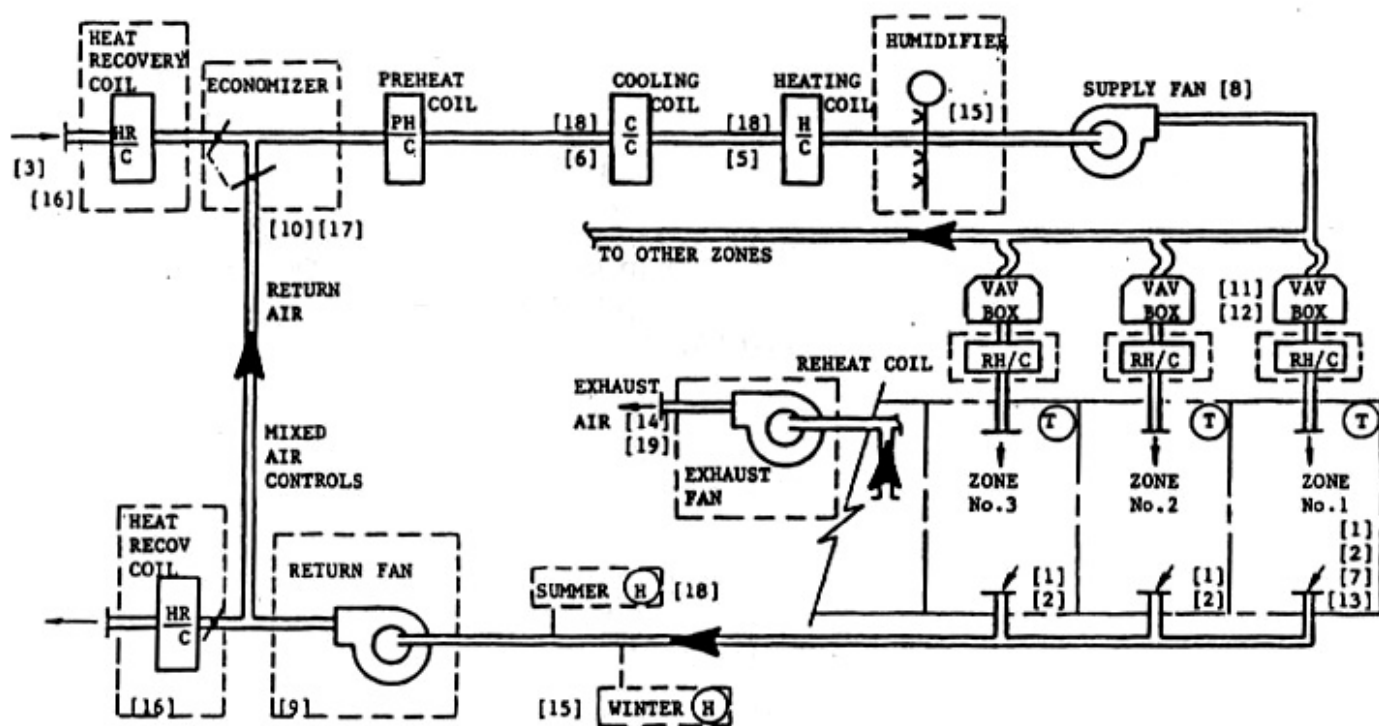


Figure 3.9: Variable-Volume Fan System with Optional Reheat (VAVS)

Suggested minimal input for VAVS system:

INPUT SYSTEMS ..

SYSTEMS-REPORT SUMMARY=(SS-A,SS-O) ..

\$ SYSTEMS SCHEDULES

FANS-ON = SCHEDULE THRU DEC 31	(WD)	(1,7)(0) (8,18)(1)
	(WEH)	(19,24)(0) (1,24)(0) ..
COOLSETPT = SCHEDULE THRU DEC 31	(WD)	(1,7)(99) (8,18)(76)
	(WEH)	(19,24)(99) (1,24)(99) ..
HEATSETPT = SCHEDULE THRU DEC 31	(WD)	(1,7)(55) (8,18)(72)
	(WEH)	(19,24)(55) (1,24)(55) ..
DHW = SCHEDULE THRU DEC 31	(WD)	(1,7)(0)
	(WEH)	(8,18)(1.0) (19,24)(0) (1,24)(0) ..

OFFICE = ZONE	DESIGN-HEAT-T	=	72	
	DESIGN-COOL-T	=	74	
	HEAT-TEMP-SCH	=	HEATSETPT	[1]
	COOL-TEMP-SCH	=	COOLSETPT	[1]
	THERMOSTAT-TYPE	=	REVERSE-ACTION	[2]
	OA-CFM/PER	=	15 ..	[3]

AC-SYST = SYSTEM	SYSTEM-TYPE	=	VAVS	
	MAX-SUPPLY-T	=	110	[4]
	HEAT-SET-T	=	70	[5]
	MIN-SUPPLY-T	=	55	[6]
	NIGHT-CYCLE-CTRL	=	CYCLE-ON-FIRST	[7]
	FAN-SCHEDULE	=	FANS-ON	[8]
	RETURN-STATIC	=	1.0	[9]
	RETURN-EFF	=	.55	[9]
	OA-CONTROL	=	TEMP	[10]
	ECONO-LIMIT-T	=	68	[10]
	MIN-CFM-RATIO	=	.3	[11]
	REHEAT-DELTA-T	=	55	[12]
	ZONE-NAMES	=	(OFFICE) ..	[13]

P1 = PLANT-ASSIGNMENT	SYSTEM-NAMES	=	(AC-SYST)
	DHW-BTU/HR	=	10000
	DHW-SCH	=	DHW ..

```

END ..
COMPUTE SYSTEMS ..
INPUT PLANT ..
P1 = PLANT-ASSIGNMENT ..
PLANT-REPORT SUMMARY = (BEPS) ..

SHW = PLANT-EQUIPMENT   TYPE = DHW-HEATER   SIZE = -999 ..
HWG = PLANT-EQUIPMENT   TYPE = HW-BOILER    SIZE = -999 ..
CHR = PLANT-EQUIPMENT   TYPE = HERM-REC-CHLR SIZE = -999 ..

PLANT-PARAMETERS   HERM-REC-COND-TYPE = AIR ..
END ..
COMPUTE PLANT ..

```

Additional capabilities for this system:

- 1) To enable an exhaust fan add the keywords EXHAUST-CFM = Value (CFM) and EXHAUST-KW = Value (.0001 is typical) to the ZONE keyword list. [14]
- 2) To enable a humidifier which requires heat to evaporate water into the air add MIN-HUMIDITY = Value (25% is typical) to the SYSTEM keyword list. [15]
- 3) To enable heat recovery to exchange relief air heat with outside air heat add RECOVERY-EFF = Value (0.6 is typical) to the SYSTEM keyword list. [16]
- 4) To disable the economizer change the OA-CONTROL = TEMP to OA-CONTROL = FIXED. [17]
- 5) To reset the supply air as a function of outside air temperature see example of this control as shown in the *Sample Run Book (2.1E)*, 31-Story Office Building, Run 1.
- 6) To enable control of maximum humidity whenever the supply air temperature is reset, insert MAXIMUM-HUMIDITY = Value (60% is allowed in the new ASHRAE 90.1 Standard) in the SYSTEM keyword list. [18]
- 7) Simulating baseboard heat in lieu or in addition to reheat coils is demonstrated in the *Sample Run Book (2.1E)*, 31-Story Office Building, Run 1.
- 8) To enable variable speed control of the fan motor, insert FAN-CONTROL = SPEED in the SYSTEM keyword list. [19]

Powered Induction Unit (PIU)

The basic PIU consists of a central air-handling unit with filter (not shown), cooling and optional heating coils, and a draw-through type supply air fan. A return air fan is also usually used. Exhaust fans are optional for any or all zones. The powered induction boxes are available in two configurations: *series* and *parallel*.

Note: On the schematic, items shown in dashed boxes are optional components.

BM013

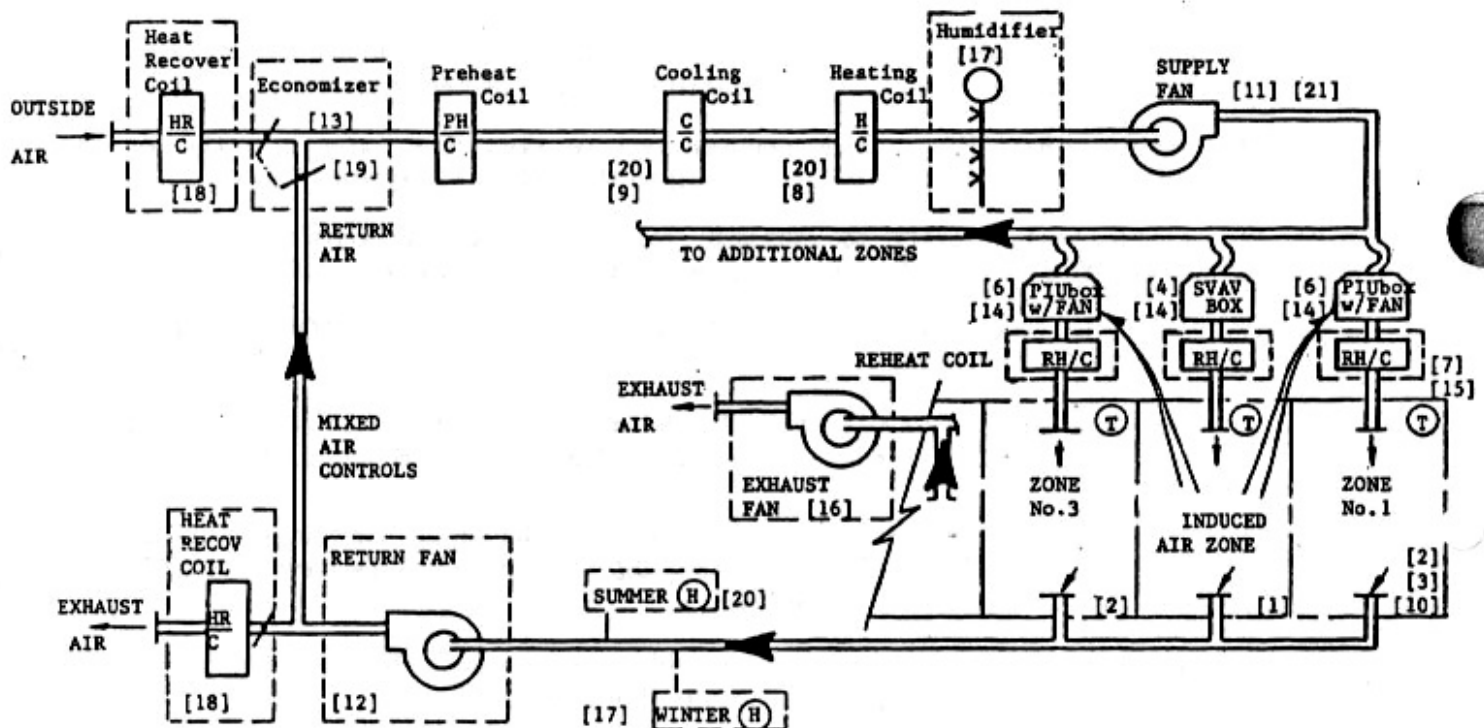


Figure 3.10: Powered Induction Unit System with Optional Reheat

The following suggested minimal input for PIU system with an economizer is shown for *series* type units configured like the sketch below. There must be more than one zone.

BM014

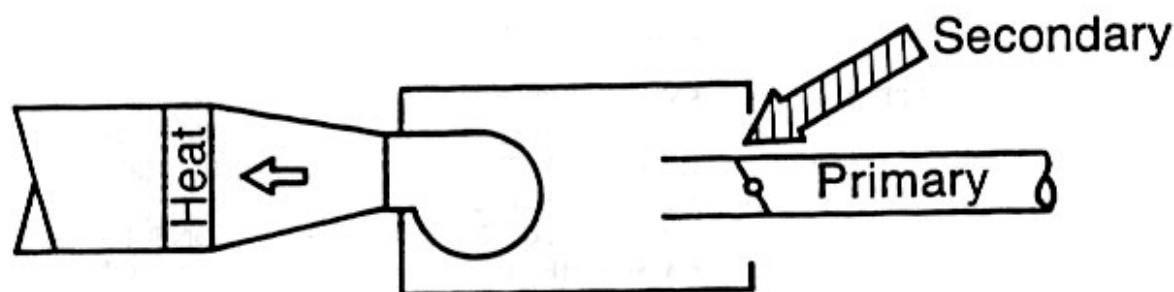


Figure 3.11: Series PIU

INPUT SYSTEMS ..

SYSTEMS-REPORT SUMMARY=(SS-A,SS-O) ..

\$ SYSTEMS SCHEDULES

FANS-ON = SCHEDULE THRU DEC 31	(WD)	(1,7)(0) (8,18)(1) (19,24)(0)
	(WEH)	(1,24)(0) ..
COOLSETPT = SCHEDULE THRU DEC 31	(WD)	(1,7)(99) (8,18)(76) (19,24)(99)
	(WEH)	(1,24)(99) ..
HEATSETPT = SCHEDULE THRU DEC 31	(WD)	(1,7)(55) (8,18)(72) (19,24)(55)
	(WEH)	(1,24)(55) ..
DHW = SCHEDULE THRU DEC 31	(WD)	(1,7)(0) (8,18)(1.0) (19,24)(0)
	(WEH)	(1,24)(0) ..

CORE = ZONE	DESIGN-HEAT-T	=	72	
[1]	DESIGN-COOL-T	=	74	
	HEAT-TEMP-SCH	=	HEATSETPT	[3]
	COOL-TEMP-SCH	=	COOLSETPT	[3]
	TERMINAL-TYPE	=	SVAV	[4]
	CFM/SQFT	=	.7	
	OA-CFM/PER	=	15 ..	[5]
OFFICE = ZONE	LIKE CORE			
[2]	TERMINAL-TYPE	=	SERIES-PIU	
	ZONE-FAN-RATIO	=	1	[6]
	ZONE-FAN-KW	=	.00033	[6]
	INDUCED-AIR-ZONE	=	CORE	[1]
	REHEAT-DELTA-T	=	55 ..	[15]
AC-SYST = SYSTEM	SYSTEM-TYPE	=	PIU	
	MAX-SUPPLY-T	=	110	[7]
	HEAT-SET-T	=	70	[8]
	MIN-SUPPLY-T	=	55	[9]
	NIGHT-CYCLE-CTRL	=	ZONE-FANS-ONLY	[10]
	FAN-SCHEDULE	=	FANS-ON	[11]
	RETURN-STATIC	=	1.0	[12]
	RETURN-EFF	=	.55	[12]
	OA-CONTROL	=	TEMP	[13]
	ECONO-LIMIT-T	=	68	[13]
	MIN-CFM-RATIO	=	.3	[4]
	ZONE-NAMES	=	(OFFICE) ..	[2]
P1 = PLANT-ASSIGNMENT	SYSTEM-NAMES	=	(AC-SYST)	
	DHW-BTU/HR	=	10000	
	DHW-SCH	=	DHW ..	
END ..				
COMPUTE SYSTEMS ..				
INPUT PLANT ..				
P1 = PLANT-ASSIGNMENT ..				
PLANT-REPORT SUMMARY = (BEPS) ..				
SHW = PLANT-EQUIPMENT	TYPE = DHW-HEATER	SIZE = -999 ..		
HWG = PLANT-EQUIPMENT	TYPE = HW-BOILER	SIZE = -999 ..		
CHR = PLANT-EQUIPMENT	TYPE = HERM-REC-CHLR	SIZE = -999 ..		
PLANT-PARAMETERS	HERM-REC-COND-TYPE = AIR ..			
END ..				
COMPUTE PLANT ..				

Following is the suggested minimal input for *parallel* type PIU units like the sketch below:

BM015

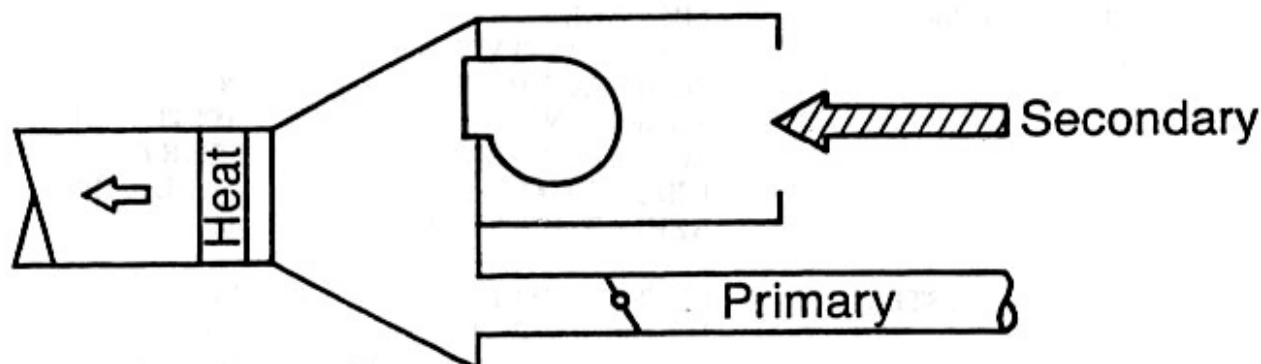


Figure 3.12: Parallel PIU

INPUT SYSTEMS ..

SYSTEMS-REPORT SUMMARY=(SS-A,SS-O) ..

\$ SYSTEMS SCHEDULES

FANS-ON = SCHEDULE THRU DEC 31 (WD) (1,7)(0) (8,18)(1)
(19,24)(0)
(WEH) (1,24)(0) ..

COOLSETPT = SCHEDULE THRU DEC 31 (WD) (1,7)(99) (8,18)(76)
(19,24)(99)
(WEH) (1,24)(99) ..

HEATSETPT = SCHEDULE THRU DEC 31 (WD) (1,7)(55) (8,18)(72)
(19,24)(55)
(WEH) (1,24)(55) ..

DHW = SCHEDULE THRU DEC 31 (WD) (1,7)(0)
(8,18)(1.0) (19,24)(0)
(WEH) (1,24)(0) ..

START-Z-FAN = SCHEDULE THRU DEC 31 (WD) (1,7) (55) (8,18) (73) (19,24) (55)
(WEH) (1,24) (55) ..

CORE = ZONE	DESIGN-HEAT-T	=	72	
[1]	DESIGN-COOL-T	=	74	
	HEAT-TEMP-SCH	=	HEATSETPT	[3]
	COOL-TEMP-SCH	=	COOLSETPT	[3]
	TERMINAL-TYPE	=	SVAV	[4]
	OA-CFM/PER	=	15 ..	[5]
OFFICE = ZONE	LIKE CORE			
[2]	TERMINAL-TYPE	=	PARALLEL-PIU	
	ZONE-FAN-RATIO	=	.8	[6]
	ZONE-FAN-KW	=	.00033	[6]
	ZONE-FAN-T-SCH	=	START-Z-FAN	[3]
	INDUCED-AIR-ZONE	=	CORE	[1]
	REHEAT-DELTA-T	=	55 ..	[15]
AC-SYST = SYSTEM	SYSTEM-TYPE	=	PIU	
	MAX-SUPPLY-T	=	110	[7]
	HEAT-SET-T	=	70	[8]
	MIN-SUPPLY-T	=	55	[9]
	NIGHT-CYCLE-CTRL	=	ZONE-FANS-ONLY	[10]
	FAN-SCHEDULE	=	FANS-ON	[11]
	RETURN-STATIC	=	1.0	[12]
	RETURN-EFF	=	.55	[12]
	OA-CONTROL	=	TEMP	[13]
	ECONO-LIMIT-T	=	68	[13]
	MIN-CFM-RATIO	=	.3	[4]
	ZONE-NAMES	=	(OFFICE) ..	[2]
P1 = PLANT-ASSIGNMENT	SYSTEM-NAMES	=	(AC-SYST)	
	DHW-BTU/HR	=	10000	
	DHW-SCH	=	DHW ..	
END ..				
COMPUTE SYSTEMS ..				
INPUT PLANT ..				
P1 = PLANT-ASSIGNMENT ..				
PLANT-REPORT SUMMARY = (BEPS) ..				
SHW = PLANT-EQUIPMENT	TYPE = DHW-HEATER	SIZE = -999 ..		
HWG = PLANT-EQUIPMENT	TYPE = HW-BOILER	SIZE = -999 ..		
CHR = PLANT-EQUIPMENT	TYPE = HERM-REC-CHLR	SIZE = -999 ..		
PLANT-PARAMETERS	HERM-REC-COND-TYPE = AIR ..			
END ..				
COMPUTE PLANT ..				